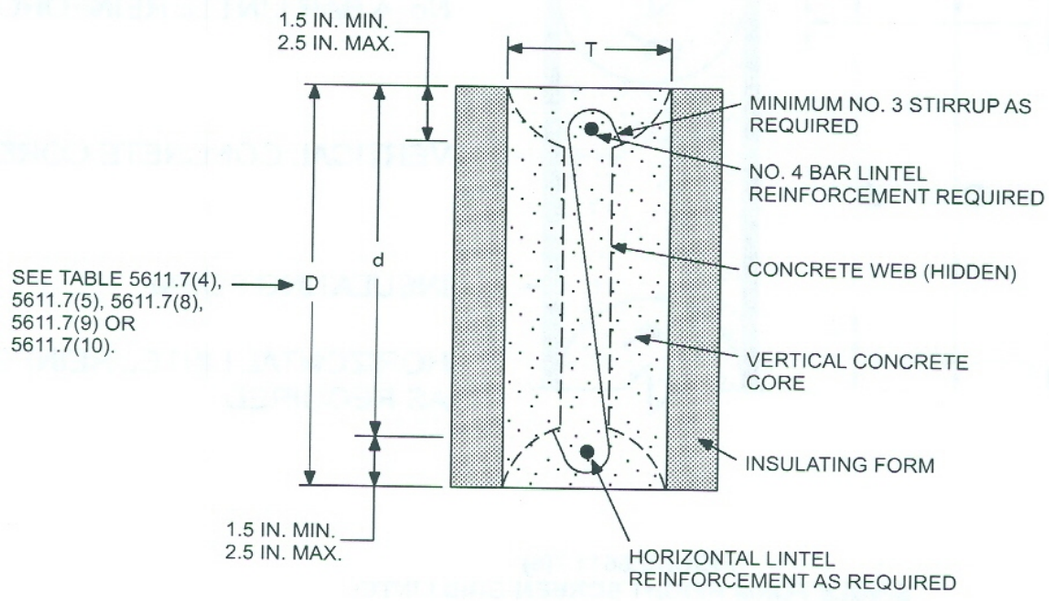
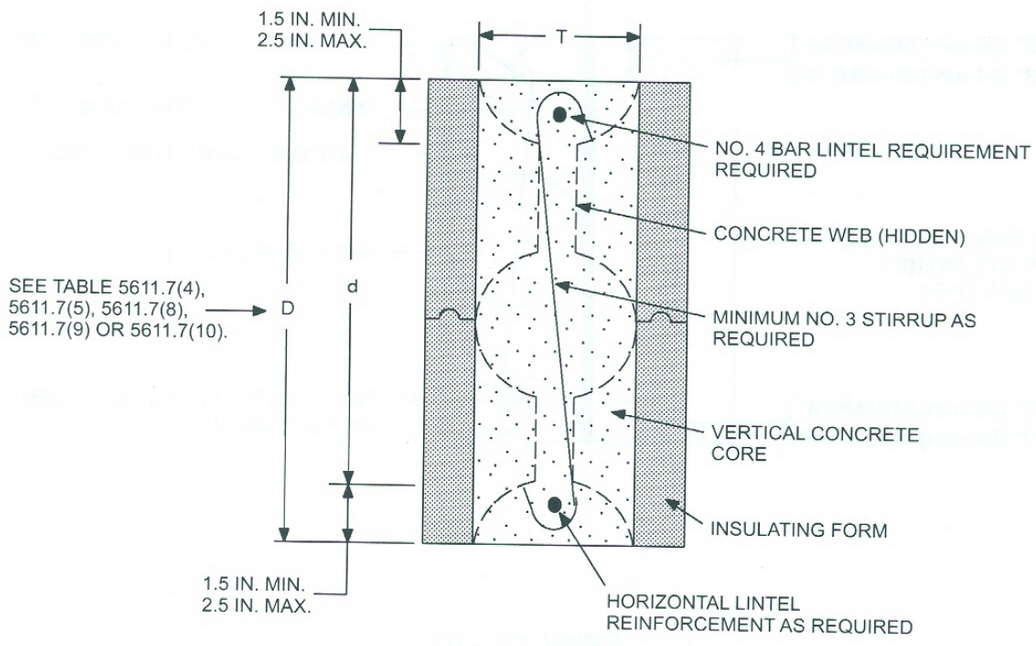
780 CMR FIGURE 5611.7(4)
SINGLE FORM HEIGHT WAFFLE-GRID LINTEL



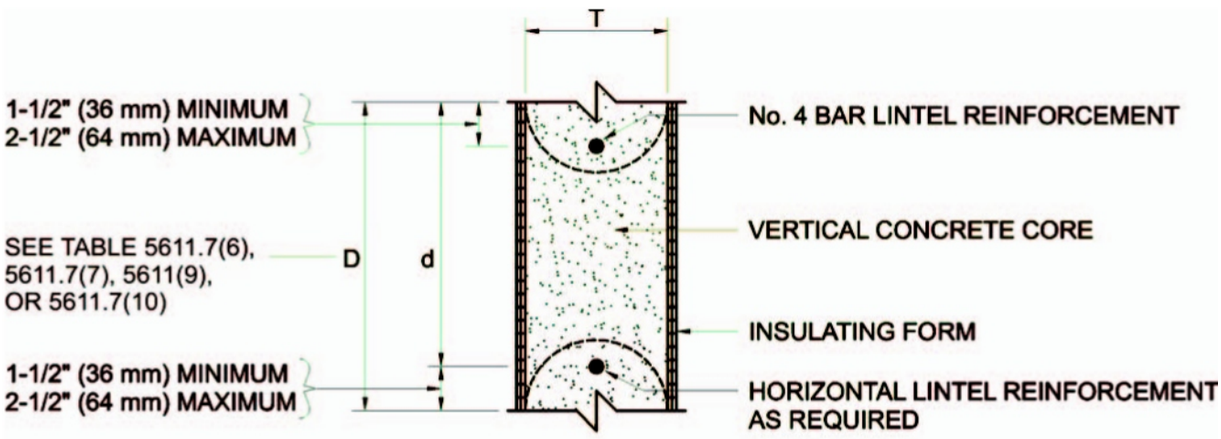
For SI: 1 inch = 25.4 mm.
NOTE: Section cut through vertical core of a waffle-grid lintel.

780 CMR FIGURE 5611.7(5)
DOUBLE FORM HEIGHT WAFFLE-GRID LINTEL

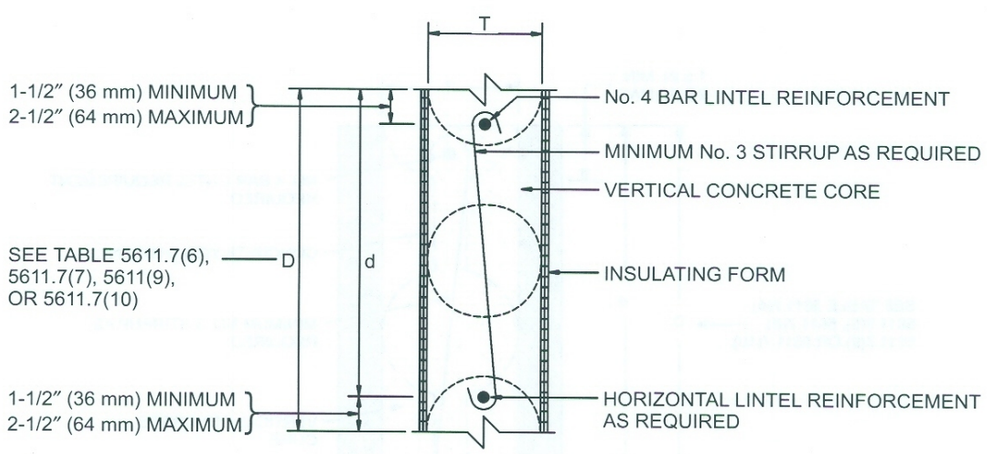


For SI: 1 inch = 25.4 mm.
NOTE: Section cut through vertical core of a waffle-grid lintel.

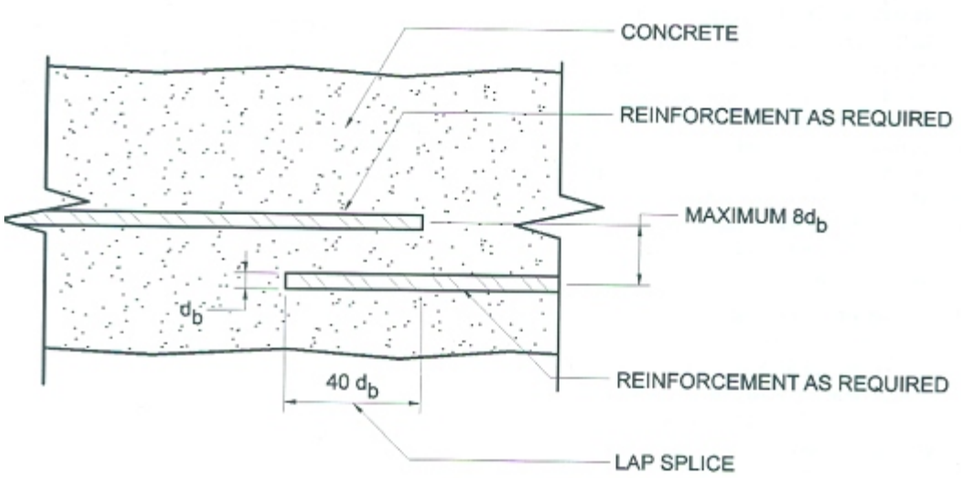
780 CMR FIGURE 5611.7(6)
SINGLE FORM HEIGHT SCREEN-GRID LINTEL



780 CMR FIGURE 5611.7(7)
DOUBLE FORM HEIGHT SCREEN-GRID LINTEL



780 CMR FIGURE 5611.7.1.4
LAP SPLICES



5611.7.2 Wall Openings. Wall openings shall have a minimum of eight inches (203 mm) of depth of concrete for flat and waffle-grid ICF walls and 12 inches (305 mm) for screen-grid walls over the length of the opening. When the depth of concrete above the opening is less than 12 inches for flat or waffle-grid walls, lintels in accordance with 780 CMR 5611.7.3 shall be provided. Reinforcement around openings shall be provided in accordance with 780 CMR Table 5611.7(1) and 780 CMR Figure 5611.7(2). All reinforcement placed horizontally above or below an opening shall extend a minimum of 24 inches (610 mm) beyond the limits of the opening. Wall opening reinforcement shall be provided in addition to the reinforcement required by 780 CMR 5611.3, 5611.4, 5611.5 and 5611.7.1. The perimeter of all wall openings shall be framed with a minimum two-inch by four-inch plate, anchored to the wall with ½-inch (12.7 mm) diameter anchor bolts spaced a maximum of 24 inches (610 mm) on center. The bolts shall be embedded into the concrete a minimum of four inches (102 mm) and have a minimum of 1½(38 mm) inches of concrete cover to the face of the wall.

Exception: The two-inch by four-inch plate is not required where the wall is formed to provide solid concrete around the perimeter of the opening with a minimum depth of four inches (102mm) for the full thickness of the wall.

5611.7.3 Lintels.

5611.7.3.1 General Requirements. Lintels shall be provided over all openings greater than or equal to two feet (610 mm) in width. Lintels for flat ICF walls shall be constructed in accordance with 780 CMR Figure 5611.7(3) and 780 CMR Table 5611.7(2) or 5611.7(3). Lintels for waffle-grid ICF walls shall be constructed in accordance with 780 CMR Figure 5611.7(4) or 780 CMR Figure 5611.7(5) and 780 CMR Table 5611.7(4) or 5611.7(5). Lintels for screen-grid ICF walls shall be constructed in accordance with 780 CMR Figure 5611.7(6) or 780 CMR Figure 5611.7(7). Lintel construction in accordance with 780 CMR Figure 5611.7(3) shall be permitted to be used with waffle-grid and screen-grid ICF wall construction. Lintel depths are permitted to be increased by the height of the ICF wall located directly above the opening, provided that the lintel depth spans the entire length of the opening.

5611.7.3.2 Stirrups. Where required, No. 3 stirrups shall be installed in flat, waffle-grid and screen-grid wall lintels in accordance with the following:

1. For flat walls the stirrups shall be spaced at a maximum spacing of $d/2$ where d equals the depth of the lintel (D) minus the bottom cover of concrete as shown in 780 CMR Figure 5611.7(3). Stirrups shall not be required in the middle portion of the span (A) per 780 CMR Figure 5611.7(2), for flat walls for a length not to exceed the values shown in parenthesis in 780 CMR Tables 5611.7(2) and 5611.7(3) or for spans in accordance with 780 CMR Table 5611.7(8).
2. For waffle-grid walls a minimum of two No. 3 stirrups shall be placed in each vertical core of waffle-grid lintels. Stirrups shall not be required in the middle portion of the span (A) per 780 CMR Figure 5611.7(2), for waffle-grid walls for a length not to exceed the values shown in parenthesis in 780 CMR Tables 5611.7(4) and 5611.7(5) or for spans in accordance with 780 CMR Table 5611.7(8).
3. For screen-grid walls one No. 3 stirrup shall be placed in each vertical core of screen-grid lintels.

Exception: Stirrups are not required in Screen-grid lintels meeting the following requirements:

1. Lintel Depth (D) = 12 inches (305mm) - spans less than or equal three feet -seven inches
2. Lintel Depth (D) = 24 inches (610mm) - spans less than or equal four feet -four inches

5611.7.3.3 Horizontal Reinforcement. One No. 4 horizontal bar shall be provided in the top of the lintel. Horizontal reinforcement placed within 12 inches (305 mm) of the top of the wall in accordance with 780 CMR 5611.7.1.3 shall be permitted to serve as the top or bottom reinforcement in the lintel provided the reinforcement meets the location requirements in 780 CMR Figure 5611.7(2), 5611.7(3), 5611.7(4), 5611.7(5), 5611.7(6), or 5611.7(7), and the size requirements in 780 CMR Tables 5611.7(2), 5611.7(3), 5611.7(4), 5611.7(5), 5611.7(6), 5611.7(7), or 5611.7(8).

5611.7.3.4 Load-bearing Walls. Lintels in flat ICF load-bearing walls shall comply with 780 CMR Table 5611.7(2), 780 CMR Table 5611.7(3) or 780 CMR Table 5611.7(8). Lintels in waffle-grid ICF load-bearing walls shall comply with 780 CMR Table 5611.7(4), 780 CMR Table 5611.7(5) or 780 CMR Table 5611.7(8). Lintels in screen-grid ICF load-bearing walls shall comply with 780 CMR Table 5611.7(6) or 780 CMR Table 5611.7(7).

Where spans larger than those permitted in 780 CMR Table 5611.7(2), 780 CMR Table 5611.7(3), 780 CMR Table 5611.7(4), 780 CMR Table 5611.7(5), 5611.7(6), 5611.7(7) or 5611.7(8) are required, the

lintels shall comply with 780 CMR Table 5611.7 (9).

5611.7.3.5 Nonload-bearing Walls. Lintels in nonload-bearing flat, waffle-grid and screen-grid ICF walls shall comply with 780 CMR Table 5611.7 (10). Stirrups are not required.

5611.7.4 Minimum length of wall without openings. The wind velocity pressures of 780 CMR Table 5611.7.4 shall be used to determine the minimum amount of solid wall length in accordance with 780 CMR Tables 5611.7(9A) through 5611.7(10B) and 780 CMR Figure 5611.7.4. The greater amount of solid wall length required by wind loading shall apply. The minimum percentage of solid wall length shall include only those solid wall segments that are a minimum of 24 inches (610 mm) in length. The maximum distance between wall segments included in determining solid wall length shall not exceed 18 feet (5486 mm). A minimum length of 24 inches (610 mm) of solid wall segment, extending the full height of each wall story, shall occur at all interior and exterior corners of exterior walls.

780 CMR TABLE 5611.7.4
WIND VELOCITY PRESSURE FOR DETERMINATION OF MINIMUM SOLID WALL LENGTH[a]

WIND SPEED (mph)[d]	VELOCITY PRESSURE (psf)		
	Exposure [b]		
	B	C	D
85	14	19	23
90	16	21	25
100	19	26	31
110	23	32	37
120	27	38	44
130	32	44	52
140	37	51	60
150	43	59	69[c]

For SI: 1 psf = 0.0479 kN/m^2; 1 mph = 1.6093 km/hr

a. Table values are based on ASCE 7-98 Figure 6-4 using a mean roof height of 35 ft (10.7 m).

b. Exposure Categories shall be determined in accordance with 780 CMR 5301.2.1.4.

c. Design is required in accordance with ACI 318 and approved manufacturer guidelines.

d. Interpolation is permitted between wind speeds.

5611.8 ICF Wall-to-floor Connections.

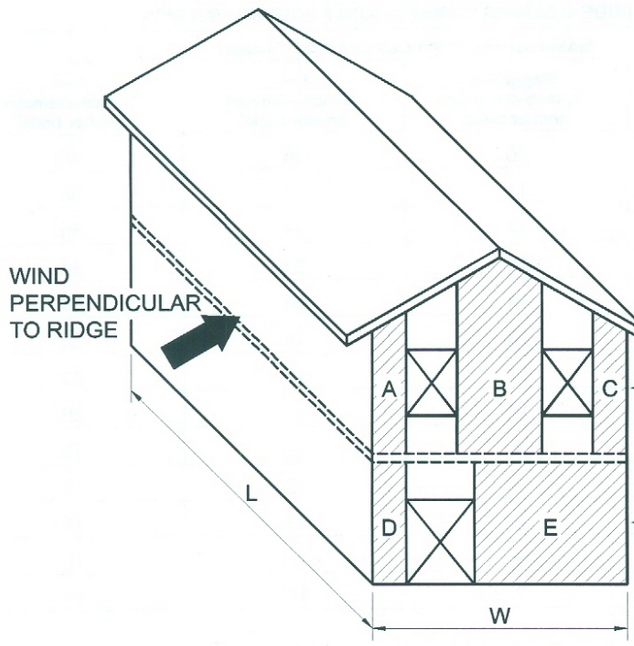
5611.8.1 Top Bearing. Floors bearing on the top of ICF foundation walls in accordance with 780 CMR Figure 5611.8(1) shall have the wood sill plate anchored to the ICF wall with minimum ½-inch (12.7 mm) diameter bolts embedded a minimum of seven inches (178 mm) and placed at a maximum spacing of six feet (1829mm) on center and not more than 12 inches (305 mm) from corners. Anchor bolts for waffle-grid and screen-grid walls shall be located in the cores. In conditions where wind speeds are in excess of 90 miles per hour (144 km/h), the ½-inch (12.7 mm) diameter anchor bolts shall be placed at a maximum spacing of four feet (1219 mm) on center. Bolts shall extend a minimum of seven inches (178 mm) into concrete. Sill plates shall be protected against decay where required by 780 CMR 5319. Cold-formed steel framing systems shall be anchored to the concrete in accordance with 780 CMR 5505.3.1 or 780 CMR 5603.3.1.

5611.8.2 Ledger Bearing. Wood ledger boards supporting bearing ends of joists or trusses shall be anchored to flat ICF walls with minimum thickness of 5.5 inches (140 mm) and to waffle- or screen-grid ICF walls with minimum nominal thickness of six inches (152 mm) in accordance with 780 CMR Figure 5611.8(2), 5611.8(3), 5611.8(4) or 5611.8(5) and 780 CMR Table 5611.8(1). Wood ledger boards supporting bearing ends of joists or trusses shall be anchored to flat ICF walls with minimum thickness of 3.5 inches (140 mm) in accordance with 780 CMR Figure 5611.8(4) or 5611.8(5) and 780 CMR Table 5611.8(1). The ledger shall be a minimum 2 by 8, No. 2 Southern Pine or No. 2 Douglas Fir. Ledgers anchored to nonload-bearing walls to support floor or roof sheathing shall be attached with ½ inch (12.7 mm) diameter or headed anchor bolts spaced a maximum of six feet (1829 mm) on center. Anchor bolts shall be embedded a minimum of four inches (102 mm) into the concrete.

5611.8.3 Floor and Roof Diaphragm Construction. Floor and roof diaphragms shall be constructed of structural wood sheathing panels, attached to wood framing in accordance with 780 CMR Table 5602.3(1) or 780 CMR Table 5602.3(2) or to cold-formed steel floor framing in accordance with 780 CMR Table 5505.3.1(2) or to cold-formed steel roof framing in accordance with 780 CMR Table 5804.3.

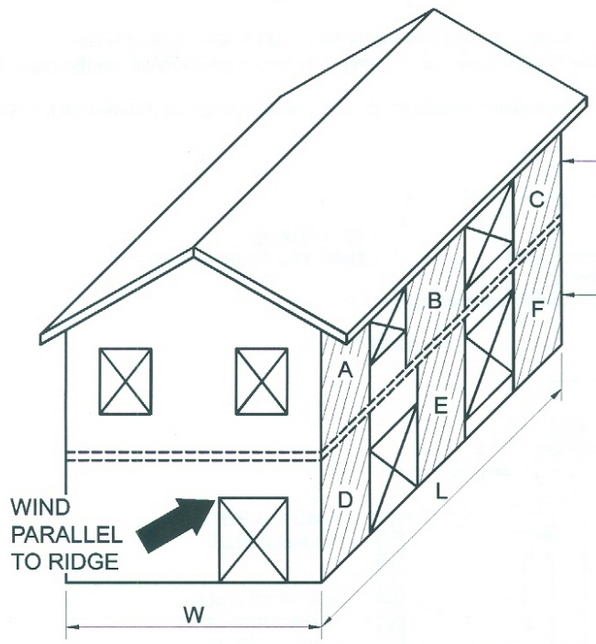
5611.9 ICF Wall to Top Sill Plate (Roof) Connections. Wood sill plates attaching roof framing to ICF walls shall be anchored with minimum ½ inch (12.7 mm) diameter anchor bolt embedded a minimum of seven inches (178mm) and placed at six feet (1829 mm) on center in accordance with 780 CMR Figure 5611.9. Anchor bolts shall be located in the cores of waffle-grid and screen-grid ICF walls. Roof assemblies subject to wind uplift pressure of 20 pounds per square foot (1.44 kN/m^2) or greater as established in 780 CMR Table 5301.2(2) shall have rafter or truss ties provided in accordance with 780 CMR Table 5802.11.

780 CMR FIGURE 5611.7.4
MINIMUM SOLID WALL LENGTH



ONE-STORY OR TOP STORY OF TWO-STORY
[TABLES 5611.7(9A) OR 5611.7(10A)]
MIN. SOLID WALL LENGTH ≤ A + B + C

FIRST STORY OF TWO-STORY
[TABLES 5611.7(9A) OR 5611.7(10A)]
MIN. SOLID WALL LENGTH ≤ D + E



ONE-STORY OR TOP STORY OF TWO-STORY
[TABLES 5611.7(9B) OR 5611.7(10B)]
MIN. SOLID WALL LENGTH ≤ A + B + C

FIRST STORY OF TWO-STORY
[TABLES 5611.7(9B) OR 5611.7(10B)]
MIN. SOLID WALL LENGTH ≤ D + E + F

NOTE: EACH WALL SEGMENT (A, B, C, D AND F) MUST MEET THE MINIMUM SOLID WALL SEGMENT LENGTH IN ORDER TO BE APPLICABLE TO THE MINIMUM SOLID WALL LENGTH EQUATIONS ABOVE.

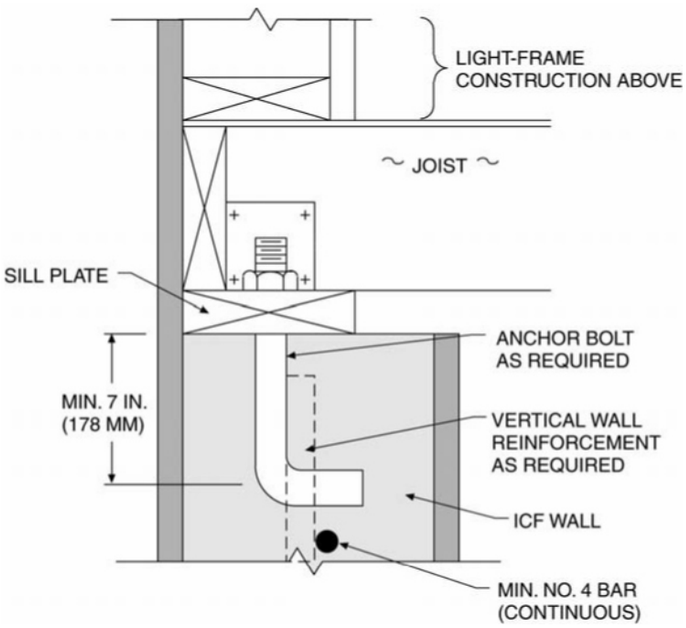
780 CMR TABLE 5611.8(1)
FLOOR LEDGER-ICF WALL CONNECTION (SIDE-BEARING CONNECTION) REQUIREMENTS[a,b,c]

MAXIMUM FLOOR CLEAR SPAN[d] (feet)	MAXIMUM ANCHOR BOLT SPACING[e] (inches)			
	Staggered ½-inch-diameter anchor bolts	Staggered ⅝-inch-diameter anchor bolts	Two ½-inch-diameter anchor bolts[f]	Two ⅝-inch-diameter anchor bolts[f]
8	18	20	36	40
10	16	18	32	36
12	14	18	28	36
14	12	16	24	32
16	10	14	20	28
18	9	13	18	26
20	8	11	16	22
22	7	10	14	20
24	7	9	14	18
26	6	9	12	18
28	6	8	12	16
30	5	8	10	16
32	5	7	10	14

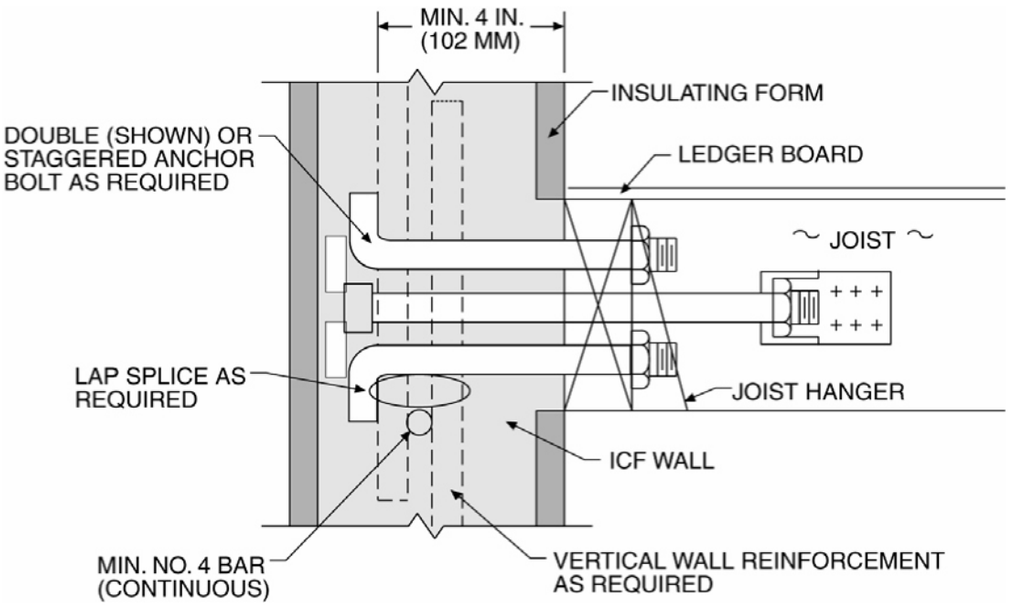
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Minimum ledger board nominal depth shall be eight inches. The thickness of the ledger board shall be a minimum of two inches. Thickness of ledger board is in nominal lumber dimensions. Ledger board shall be minimum No. 2 Grade.
b. Minimum edge distance shall be two inches for ½-inch-diameter anchor bolts and 2.5 inches for ⅝-inch-diameter anchor bolts.
c. Interpolation is permitted between floor spans.
d. Floor span corresponds to the clear span of the floor structure (i.e., joists or trusses) spanning between load-bearing walls or beams.
e. Anchor bolts shall extend through the ledger to the center of the flat ICF wall thickness or the center of the horizontal or vertical core thickness of the waffle-grid or screen-grid ICF wall system.
f. Minimum vertical distance between bolts shall be 1.5 inches for ½-inch-diameter anchor bolts and two inches for ⅝-inch-diameter anchor bolts.

780 CMR FIGURE 5611.8(1)
SECTION CUT THROUGH FLAT WALL OR VERTICAL CORE OF WAFFLE- OR SCREEN-GRID WALL

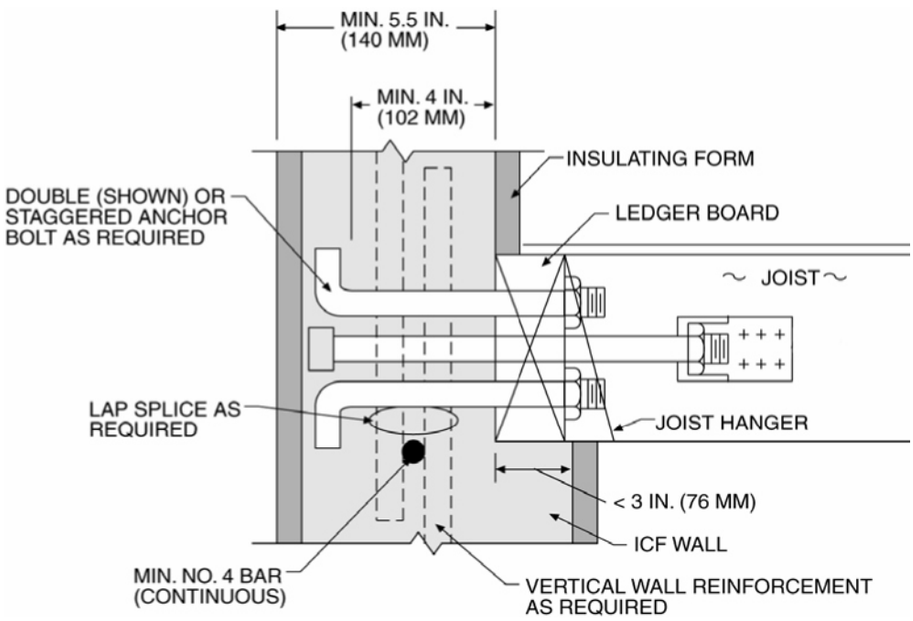


780 CMR FIGURE 5611.8(2)
FLOOR LEDGER—ICF WALL CONNECTION (SIDE-BEARING CONNECTION)



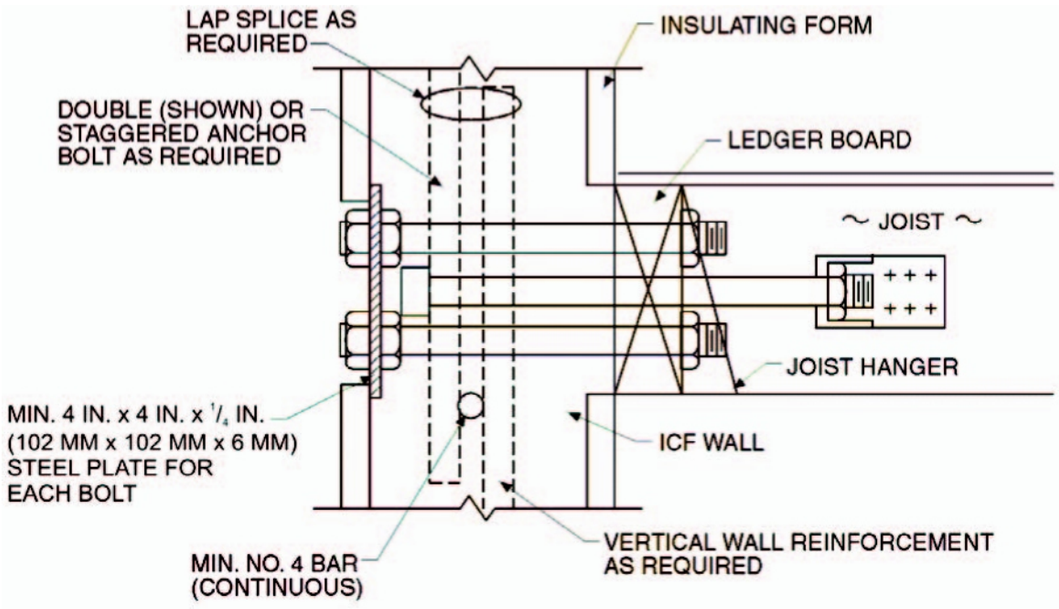
For SI: 1 inch = 25.4 mm.
NOTE: Section cut through flat wall or vertical core of a waffle- or screen-grid wall.

780 CMR FIGURE 5611.8(3)
FLOOR LEDGER—ICF WALL CONNECTION (LEDGE-BEARING CONNECTION)



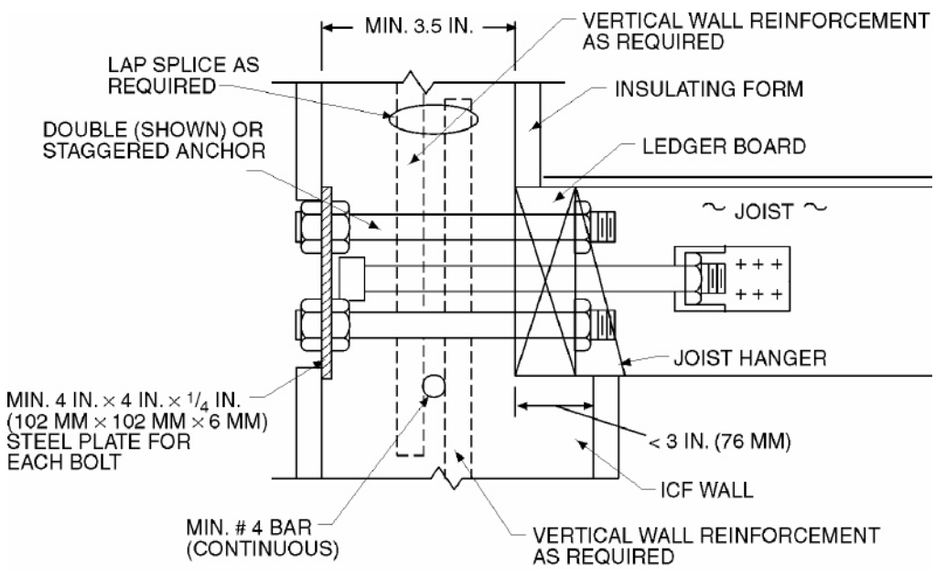
For SI: 1 inch = 25.4 mm.
NOTE: Section cut through flat wall or vertical core of a waffle- or screen-grid wall.

780 CMR FIGURE 5611.8(4)
WOOD FLOOR LEDGER—ICF WALL SYSTEM CONNECTION (THROUGH-BOLT SIDE-BEARING CONNECTION)



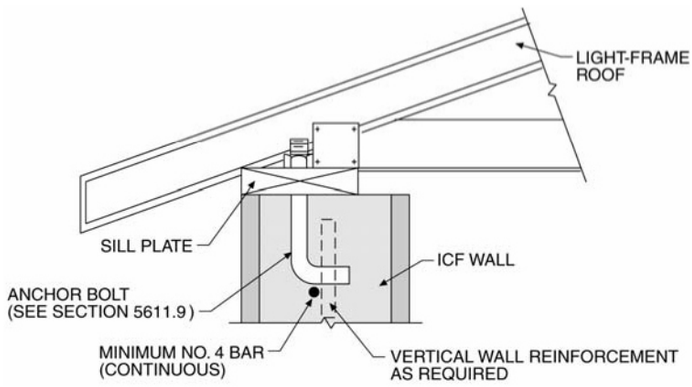
For SI: 1 inch = 25.4 mm.
NOTE: Section cut through flat wall.

780 CMR FIGURE 5611.8(5)
FLOOR LEDGER—ICF WALL CONNECTION



For SI: 1 inch = 25.4 mm.

780 CMR FIGURE 5611.9
ROOF SILL PLATE—ICF WALL CONNECTION



NOTE: Section cut through flat wall or vertical core of a waffle- or screen-grid wall.

780 CMR 5612 CONVENTIONALLY FORMED CONCRETE WALL CONSTRUCTION

5612.1 General. Conventionally formed concrete walls with flat surfaces shall be designed and constructed in accordance with the provisions of 780 CMR 5611 for Flat ICF walls or in accordance with the provisions of ACI 318.

780 CMR 5613 EXTERIOR WINDOWS AND GLASS DOORS

5613.1 General. 780 CMR 5613 prescribes performance and construction requirements for exterior window systems installed in wall systems. Waterproofing, sealing and flashing systems are not included in the scope of 780 CMR 5613.

5613.2 Performance. Exterior windows and doors shall be designed to resist the design wind loads specified in 780 CMR Table 5301.2(2) adjusted for height and exposure per 780 CMR Table 5301.2(3).

5613.3 Testing and Labeling. Exterior windows and glass doors shall be tested by an approved independent laboratory, and bear a label identifying manufacturer, performance characteristics and approved inspection agency to indicate compliance with the requirements of one of the following specifications:

AAMA/NWWDA 101/I.S.2
AAMA/WDMA 101/I.S.2/NAFS

Exceptions:

1. Decorative glazed openings.
2. Exterior window and door assemblies not included within the scope of AAMA/NWWDA 101/I.S.2 or AAMA/WDMA 101/I.S.2/NAFS shall be tested in accordance with ASTM E 330. Assemblies covered by this exception containing glass shall comply with 780 CMR 5308.5.
3. Structural wind load design pressures for window units smaller than the size tested in accordance with 780 CMR 5613 shall be permitted to be higher than the design value of the tested unit provided such higher pressures are determined by accepted engineering analysis. All components of the small unit shall be the same as the tested unit. Where such calculated design pressures are used they shall be validated by an additional test of the window unit having the highest allowable design pressure.

5613.4 Windborne Debris Protection. Protection of exterior windows and glass doors in buildings located in hurricane-prone regions from windborne debris shall be in accordance with 780 CMR 5301.2.1.2.

5613.5 Anchorage Methods. The methods cited in 780 CMR 5613.5 apply only to anchorage of window and glass door assemblies to the main force-resisting system.

5613.5.1 Anchoring Requirements. Window and glass door assemblies shall be anchored in accordance with the published manufacturer's recommendations to achieve the design pressure specified. Substitute anchoring systems used for substrates not specified by the fenestration manufacturer shall provide equal or greater anchoring performance as demonstrated by accepted engineering practice.

5613.5.2 Anchorage Details. Products shall be anchored in accordance with the minimum requirements illustrated in 780 CMR Figures 5613.5(1), 5613.5(2), 5613.5(3), 5613.5(4), 5613.5(5), 5613.5(6), 5613.5(7) and 5613.5(8).

5613.5.2.1 Masonry, Concrete or Other Structural Substrate. Where the wood shim or buck thickness is less than 1½ inches (38mm), window and glass door assemblies shall be anchored through the jamb, or by jamb clip and anchors shall be embedded directly into the masonry, concrete or other substantial substrate material. Anchors shall adequately transfer load from the window or door frame into the rough opening substrate (*see* 780 CMR Figures 5613.5(1) and 5613.5(2)).

Where the wood shim or buck thickness is 1.5 inches (38 mm) or greater, the buck is securely fastened to the masonry, concrete or other substantial substrate and the buck extends beyond the interior face of the window or door frame, window and glass door assemblies shall be anchored through the jamb, or by jamb clip, or through the flange to the secured wood buck. Anchors shall be embedded into the secured wood buck to adequately transfer load from the window or door frame assembly (780 CMR Figures 5613.5(3), 5613.5(4) and 5613.5(5)).

5613.5.2.2 Wood or Other Approved Framing Material. Where the framing material is wood or other approved framing material, window and glass door assemblies shall be anchored through the frame, or by frame clip, or through the flange. Anchors shall be embedded into the frame construction to adequately transfer load (780 CMR Figures 5613.5(6), 5613.5(7) and 5613.5(8)).

5613.6 Mullions Occurring Between Individual Window and Glass Door Assemblies.

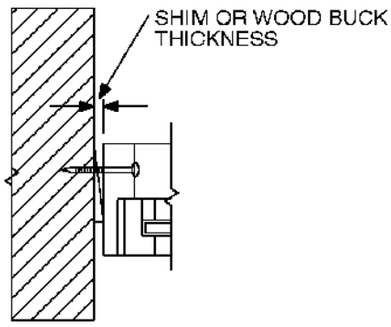
5613.6.1 Mullions. Mullions shall be tested by an approved testing laboratory or be engineered in accordance with accepted engineering practice. Both methods shall use performance criteria cited in 780 CMR 5613.6.2, 5613.6.3 and 5613.6.4.

5613.6.2 Load Transfer. Mullions shall be designed to transfer the design pressure loads applied by the window and door assemblies to the rough opening substrate.

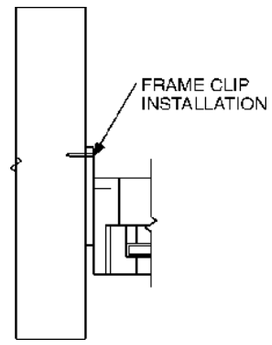
5613.6.3 Deflection. Mullions shall be capable of resisting the design pressure loads applied by the window and door assemblies to be supported without deflecting more than $L/175$, where L = the span of mullion in inches.

5613.6.4 Structural Safety Factor. Mullions shall be capable of resisting a load of 1.5 times the design pressure loads applied by the window and door assemblies to be supported without exceeding the appropriate material stress levels. If tested by an approved laboratory, the 1.5 times the design pressure load shall be sustained for ten seconds, and the permanent deformation shall not exceed 0.4% of the mullion span after the 1.5 times design pressure load is removed.

780 CMR FIGURE 5613.5(1)
THROUGH THE FRAME

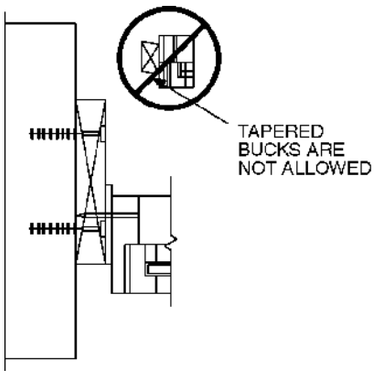


780 CMR FIGURE 5613.5(2)
FRAME CLIP



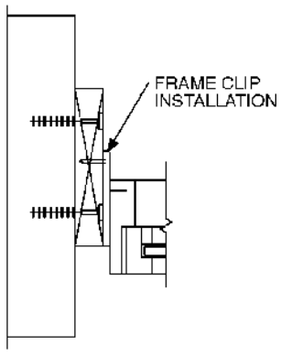
APPLY FRAME CLIP TO WINDOW OR DOOR IN ACCORDANCE WITH PUBLISHED MANUFACTURER'S RECOMMENDATIONS.

780 CMR FIGURE 5613.5(3)
THROUGH THE FRAME



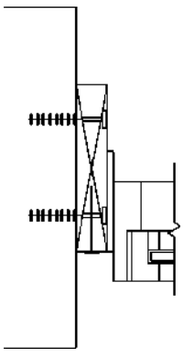
THROUGH THE FRAME ANCHORING METHOD. ANCHORS SHALL BE PROVIDED TO TRANSFER LOAD FROM THE WINDOW OR DOOR FRAME INTO THE ROUGH OPENING SUBSTRATE.

780 CMR FIGURE 5613.5(4)
FRAME CLIP



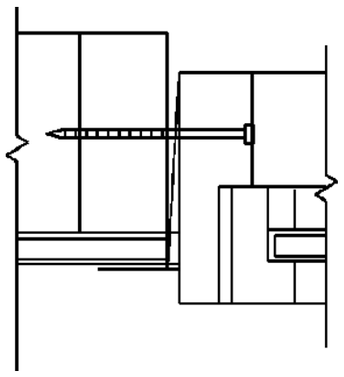
APPLY FRAME CLIP TO WINDOW OR DOOR FRAME IN ACCORDANCE WITH PUBLISHED MANUFACTURER'S RECOMMENDATIONS. ANCHORS SHALL BE PROVIDED TO TRANSFER LOAD FROM THE FRAME CLIP INTO THE ROUGH OPENING SUBSTRATE

780 CMR FIGURE 5613.5(5)
THROUGH THE FLANGE

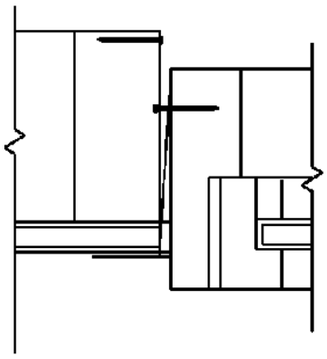


APPLY ANCHORS THROUGH FLANGE IN ACCORDANCE WITH PUBLISHED MANUFACTURERS RECOMMENDATIONS

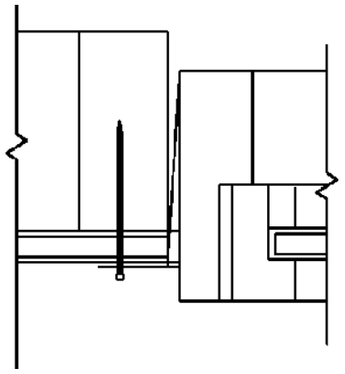
780 CMR FIGURE 5613.5(6)
THROUGH THE FRAME



780 CMR FIGURE 5613.5(7)
FRAME CLIP



780 CMR FIGURE 5613.5(8)
THROUGH THE FLANGE



NON-TEXT PAGE